

What is claimed:

1 1. A method of pasteurizing in-shell chicken eggs, comprising:
2 (1) placing the eggs in a heated fluid having a temperature of between
3 about 128°F and 146°F;

4 (2) allowing the eggs to dwell in the heated fluid until there is a log
5 reduction of at least 4.6 of any Salmonella bacteria within the eggs;
6 (3) removing the eggs from the heated fluid and into a gaseous
7 atmosphere; and

8 (4) contacting the eggs with an antibacterial fluid containing an
9 antibacterial agent.

1 2. The method of claim 1, wherein the log reduction is about above 4.75.

1 3. The method of claim 2, where the log reduction is about 6 to 12 logs.

1 4. The method of claim 1, wherein the heated fluid is at different
2 temperatures.

1 5. The method of claim 4, wherein a first temperature of the heated fluid
2 is about 139°F to 146°F, and a second temperature of the heated fluid is about
3 130°F to less than 135°F and a third temperature of the heated fluid is about 135°F
4 to 138°F.

1 6. The method of claim 4, wherein the heat fluid is water and the water is
2 contained in an elongated tank through which the eggs traverse from an entrance
3 end of the tank to a middle zone of the tank and to an exit end of the tank.

1 7. The method of claim 6, wherein near a bottom of the tank a plurality of
2 jets are dispersed through which a jet fluid is passed from the jets into the water.

1 8. The method of claim 7, wherein some of the jets are arranged

2 transverse to a major axis of the tank and one series of the transverse jets is spaced
3 apart along the major axis from another series of the transverse jets.

1 9. The method of claim 8, wherein the jet fluid rises vertically in the water
2 and to at least near a top of the water to provide a jet fluid wall in the water near
3 each of the spaced apart series of jets, and between two such jet fluid walls a jet
4 fluid walled compartment is formed.

1 10. The method of claim 9, wherein there are at least two jet fluid walled
2 compartments along the major axis and at least two of the compartments are
3 maintained at different temperatures.

1 11. The method of claim 10, wherein the jet fluid is a gas or liquid.

1 12. The method of claim 11, wherein the gas air and the liquid is water.

1 13. The method of claim 10, wherein at least three compartments are
2 maintained at different temperatures.

1 14. The method of claim 13, wherein there are an entrance compartment,
2 a middle compartment, and an exit compartment and the length along the major axis
3 of the tank of the entrance compartment is from 0.1 to 0.3 the length of the tank, the
4 middle compartment is from 0.3 to 0.7 the length and the exit compartment is from
5 about 0.1 to 0.3 the length and the temperature within the entrance compartment is
6 from 139°F to 146°F, the middle compartment is from 132° to less than 135°F and
7 the exit end compartment is from 135°F to 138°F.

1 15. The method of claim 14, wherein the length of the entrance
2 compartment is from about 0.1 to about 0.2, the middle compartment is from about
3 0.2 to 0.6 and the exit compartment from about 0.1 to 0.2 and the respective
4 temperatures are from about 141°F to 143°F, 133°F to 134.5°F and 136°F to
5 139°F.

1 16. The method of claim 1, wherein the antibacterial agent is any one of
2 FDA Food Use approved bacteriacides.

1 17. The method of claim 16, wherein the bactericide is selected from
2 chlorine, bromine, ozone, hydrogen peroxide and quaternary ammonia compounds.

1 18. The method of claim 16, wherein the antibacterial fluid is water.

1 19. The method of claim 1, wherein the antibacterial fluid is contacted with
2 the eggs and is also contacted with mechanical equipment handling the eggs
3 subsequent to the eggs exiting the heated fluid.

1 20. The method of claim 19, wherein the antibacterial fluid is sprayed onto
2 the eggs and onto the mechanical equipment and prior to the eggs contacting the
3 mechanical equipment.

1 21. The method of claim 1, wherein after contacting the eggs with the
2 antibacterial fluid the eggs are contacted with an egg pore sealant.

1 22. The method of claim 21, wherein the pore sealant has an antibacterial
2 agent therein.

1 23. The method of claim 22, wherein the antibacterial agent is a FDA Food
2 Use approved bactericide.

1 24. The method of claim 21, where the pore sealant is selected from food
2 grade polymers, waxes and soluble proteins.

1 25. The method of claim 24, wherein the sealant is wax.

1 26. The method of claim 21, wherein the sealant is sprayed onto the eggs.

1 27. The method of claim 21, wherein after contacting the eggs with the
2 sealant, an amount of sealant which remains on the eggs is at least equal to 90% of
3 natural egg pore sealant removed from the eggs during the dwell of the eggs in the
4 heated fluid.

1 28. The method of claim 1, wherein the eggs exit the heated fluid with a
2 log reduction of about at least 4.6 and while the eggs are in the gaseous
3 atmosphere residual heat in the eggs increases the log reduction to at least 5.

1 29. The method of claim 28, wherein the eggs are in the gaseous
2 atmosphere for about 1.5 to 3.5 minutes.

1 30. A method of pasteurizing in-shell chicken eggs comprising:
2 (1) placing the eggs in a heated fluid having temperatures between
3 about 128°F and 146°F so as to heat the eggs, said heated fluid having a first
4 temperature of about 139°F to 146°F, a second temperature from about 130°F to
5 less than 135°F and a third temperature from about 135°F to 138°F, and wherein
6 the first, second, and third temperatures of the heated fluid are maintained in
7 separate zones of the heated fluid;
8 (2) allowing the eggs to pass through the first, second, and third
9 temperatures in a time period which causes at least a log reduction of 4.6 of any
10 Salmonella bacteria within the eggs; and
11 (3) removing the eggs from the heated fluid to a gaseous
12 atmosphere and allowing the eggs to cool.

1 31. The process of claim 30, wherein while the eggs are in the gaseous
2 atmosphere, the eggs are contacted with an antibacterial fluid containing an
3 antibacterial agent.

1 32. The process of claim 31, wherein after the eggs are contacted with the
2 antibacterial fluid, the eggs are contacted with an egg pore sealant.

1 33. The process of claim 32, wherein the sealant has an antibacterial
2 agent therein.

1 34. The method of claim 30, wherein the eggs remain in the gaseous
2 atmosphere until the eggs reach a final log reduction of at least about 5.

1 35. The method of claim 34, wherein a final log reduction is up to about 12.

1 36. The method of claim 30, wherein the heated fluid is water and the
2 water is contained in an elongated tank through which the eggs traverse from an
3 entrance end of the tank to a middle zone of the tank and to an exit end of the tank
4 and near a bottom of the tank a plurality of jets are dispersed through which a jet
5 fluid is passed from the jets into the water.

1 37. The method of claim 36, wherein some of the jets are arranged
2 transverse to a major axis of the tank.

1 38. The method of claim 37, wherein one series of the transverse jets is
2 spaced apart along a major axis from another series of transverse jets.

1 39. The method of claim 38, wherein the jet fluid rises vertically in the
2 water and to at least near a top of the water to provide a jet fluid wall in the water
3 near each of the spaced apart series of jets, and between two such jet fluid walls a
4 jet fluid walled compartment is formed.

1 40. The method of claim 39, wherein there are at least three jet fluid walled
2 compartments along the major axis and the three compartments are maintained at
3 the first, second and third temperatures.

1 41. The method of claim 40, wherein the jet fluid is a gas or liquid.

1 42. The method of claim 40, wherein there are an entrance compartment,

2 a middle compartment and an exit compartment and the length along the major axis
3 of the tank of the entrance compartment is from 0.1 to 0.3 the length of the tank, the
4 middle compartment is from 0.3 to 0.7 the length and the exit compartment is 0.1 to
5 0.3 the length.

1 43. The method of claim 42, wherein the length of the entrance
2 compartment is from about 0.1 to about 0.2, the middle portion is from about 0.2 to
3 0.6 and the exits from about 0.1 to 0.2 and the respective temperatures are from
4 about 141°F to 143°F, 133°F to 135°F and 136°F to 137°F.

1 44. The method of claim 31, wherein the antibacterial agent is any one of
2 FDA Food Use approved bactericides.

1 45. The method of claim 31, wherein the antibacterial fluid is contacted
2 with the eggs and is also contacted with mechanical equipment handling the eggs
3 subsequent to the eggs exiting the heated fluid.

1 46. The method of claim 45, wherein the eggs and mechanical equipment
2 are sprayed with the antibacterial fluid and the mechanical equipment includes egg
3 destacking equipment.

1 47. The method of claim 32, wherein the pore sealant has an antibacterial
2 agent therein.

1 48. The method of claim 47, wherein the antibacterial agent is a FDA Food
2 Use approved bactericide.

1 49. The method of claim 32, wherein the pore sealant is selected from
2 food grade polymers, waxes and soluble proteins.

1 50. The method of claim 49, wherein the sealant is wax.

1 51. The method of claim 32, wherein the sealant is sprayed onto the eggs.

1 52. The method of claim 30, wherein while the eggs are in the gaseous
2 atmosphere residual heat in the eggs increases the log reduction to at least 5.

1 53. The method of claim 52, wherein while the eggs are in the gaseous
2 atmosphere for about 1.5 to 3.5 minutes.

1 54. The method of pasteurizing in shell chicken eggs, comprising:
2 (1) passing the eggs through a tank containing a heated fluid at
3 different temperatures in separate zones of the heated fluid, said different
4 temperatures being from about 139°F to 146°F in a first zone, from about 130°F to
5 less than 135°F in a second zone and from about 135°F to about 138°F in a third
6 zone; and

7 (2) removing the eggs from the heated fluid when the eggs have
8 reached at least about 4.6 log reduction of any Salmonella within the eggs.

1 55. The method of claim 54, wherein the log reduction is about 4.8.

1 56. The method of claim 55, wherein the log reduction is up to 12.

1 57. The method of claim 54, wherein the heated fluid is water and the eggs
2 traverse the tank from an entrance end to a middle zone of the tank and to an exit
3 end of the tank, and the first, second and third temperature zones corresponds,
4 respectively, thereto.

1 58. The method of claim 57, wherein near a bottom of the tank a plurality
2 of jets is dispersed through which a jet fluid is passed from the jets into the water.

1 59. The method of claim 58, wherein some of the jets are arranged
2 transverse to a major axis of the tank.

1 60. The method of claim 59, wherein one series of the transverse jets is
2 spaced a part along the major axis from another series of transverse jets.

1 61. The method of claim 60, wherein the jet fluid rises vertically in the
2 water and to at least near a top of the water to provide a jet fluid wall in the water
3 near each of the spaced apart series of jets, and between two such jet fluid walls a
4 jet fluid walled compartment is formed.

1 62. The method of claim 61, wherein there are at least two walled
2 compartments along the major axis and the at least two walled compartments are
3 maintained at the different temperatures.

1 63. The method of claim 58, wherein the jet fluid is a gas or liquid.

1 64. The method of claim 63, wherein the gas is air and the liquid is water.

1 65. The method of claim 62, wherein there are an entrance compartment,
2 a middle compartment and an exit compartment and the lengths along the major
3 axis of the tank of the entrance compartment is from 0.1 to 0.3 the length of the
4 tank, the middle compartment is from 0.3 to 0.7 the length and the exit compartment
5 is from 0.1 to 0.3 the length and the temperature within each of the compartments
6 corresponds to the different temperatures, respectively.

1 66. The method of claim 65, wherein the length of the entrance
2 compartment is from about 0.1 to 0.2, the middle compartment is from about 0.2 to
3 0.6 and the exit compartment is from about 0.1 to 0.2 and the respective
4 temperatures are from about 141°F to 142°F, 133°F to less than 135°F and 136° to
5 137°F.

1 67. The method of claim 54, wherein after the eggs are removed from the
2 heated fluid, the eggs are passed into a gaseous atmosphere.

1 68. The method of claim 67, wherein after the eggs pass into the gaseous
2 atmosphere the eggs are contacted with an antibacterial fluid containing an
3 antibacterial agent.

1 69. The method of claim 68, wherein the antibacterial agent is any one of
2 FDA Food Use approved bactericides.

1 70. The method of claim 68, wherein the antibacterial fluid is contacted
2 onto the eggs and is also contacted onto mechanical equipment handling the eggs.

1 71. The method of claim 70, wherein the antibacterial fluid is sprayed onto
2 the eggs and the mechanical equipment prior to the eggs contacting the mechanical
3 equipment.

1 72. The method of claim 68, wherein after contacting the eggs with the
2 antibacterial fluid, the eggs are contacted with an egg pore sealant.

1 73. The method of claim 73, wherein the pore sealant has an antibacterial
2 agent therein.

1 74. The method of claim 73, wherein the antibacterial agent is a FDA Food
2 Use approved bactericide.

1 75. The method of claim 72, wherein the pore sealant is selected from
2 food grade polymers, waxes and soluble proteins.

1 76. The method of claim 72, wherein the pore sealant is at least
2 translucent when applied to the eggs.

1 77. The method of claim 72, wherein the sealant is wax.

1 78. The method of claim 72, wherein the sealant is sprayed onto the eggs.

2 79. The method of claim 72, wherein after contacting the eggs with the
3 sealant, the amount of sealant which remains on the eggs is at least equal to 85% of
4 natural egg pore sealant removed from the eggs during the dwell of the eggs in the
5 heated fluid.

1 80. The method of claim 79, wherein the amount is at least 90%.

1 81. The method of claim 67, wherein while the eggs are in the gaseous
2 atmosphere residual heat in the eggs increases the log reduction to at least about 5.

1 82. The method of claim 81, wherein the eggs are in the gaseous
2 atmosphere for about 1.5 to 3.5 minutes.

1 83. A pasteurized egg having an antibacterial fluid disposed between an
2 egg membrane and an inside of a shell of the egg.

1 84. An apparatus for pasteurizing in shell chicken eggs, comprising a
2 support for the eggs and an application device in proximity to the support for
3 applying to at least partially pasteurized eggs an antibacterial fluid.

1 85. A method of protecting an at least partially pasteurized egg from rot
2 bacteria while the egg is in a heated condition, comprising contacting the egg with
3 an antibacterial fluid having an antibacterial agent therein.

1 86. The method of claim 85, wherein the antibacterial agent is a FDA Food
2 Use bactericide.

1 87. The method of claim 86, wherein the bactericide is a quaternary
2 ammonium compound.